

The disappearance of the border barrier in some European Union countries' bilateral trade

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Abstract

This paper estimates the tariff equivalent of the border barrier in each bilateral trade among European Union countries. The results show that there are large differences in the border barrier across European Union countries' bilateral trade. In some bilateral trade flows the border barrier has almost disappeared, whereas in other cases it is still equivalent to a 75 per cent tariff. The results also show that some countries have low border barriers in most of their bilateral trade flows with other EU members, whereas other countries persistently present large border barriers.

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1. Introduction

In a famous paper published in 1995, John McCallum found that Canadian provinces trade 22 times more among themselves than with US States, once differences in income and distance were taken into account. This finding was striking considering that the Canadian – US border seemed to be one of the “thinnest” in the world, due to very low trade barriers, the use of a common language and the existence of highly integrated transport infrastructures. In fact, Obstfeld and Rogoff (2000) considered this case as one of the six major puzzles of open economy macroeconomics.

Motivated by McCallum's finding, different studies have aimed to estimate the extent of the border effect among European Union (EU) countries (Wei, 1996; Head and Mayer, 2000; Nitsch, 2000; Evans, 2003; Chen, 2004). The EU has been considered a relevant case to test the pervasiveness of home-bias in trade, as this economic union has undertaken a large range of measures in order to facilitate trade among country members. These studies have estimated the average border effect among EU countries; that is, they have assumed that the barrier that borders impose is equal in all trade flows among EU countries. The aim of this paper is to test the validity of this assumption. We use a structural gravity model to estimate the tariff equivalent of the border barrier in each bilateral trade among EU countries. Our results show that there are large differences in the border barrier across EU countries' bilateral trade: in some cases the border effect has almost disappeared whereas in other cases large barriers remain.

The remainder of the paper is organised as follows. The next section explains the model that is used for the analysis. Section 3 analyses the data-base. Section 4 presents the empirical results and the last section summarises the main findings.

2. The model

In order to estimate the border effect in each bilateral trade among EU countries we use the gravity model developed in Anderson and van Wincoop (2003). In this model each good is differentiated by the place of origin and each country is completely specialised in the production of one good, whose supply is fixed. Demand is modelled through a constant elasticity of substitution (CES) utility function.

With these building blocks the model leads to the following exports' equation:

$$x_{ij} = \left(\frac{\beta_i p_i t_{ij}}{P_j} \right)^{(1-\sigma)} y_j \quad (1)$$

where x_{ij} is exports from country i to country j , β_i a distribution parameter, p_i the supply price of the good produced in country i , t_{ij} the trade cost factor between i and j , σ the elasticity of substitution, P_j the consumer price index in country j and y_j the gross domestic production in country j . According to equation (1) the value of exports from country i to country j is positively related with income in country j and negatively related with the price of country i 's product relative to the price of the other competitors' products in country j .

The consumer price index is calculated as:

$$P_j = \left[\sum_i (\beta_i p_i t_{ij})^{1-\sigma} \right]^{1/(1-\sigma)} \quad (2)$$

Anderson and van Wincoop use market clearance conditions (country i 's income should equal the value of its exports plus the value of the production sold in the domestic market), and assume that trade barriers are symmetric, that is $t_{ji}=t_{ij}$. These steps allow, firstly, to define each country's consumer price index as a function of partner countries' price indexes and trade barriers:

$$P_j^{1-\sigma} = \sum_i P_i^{\sigma-1} \theta_i t_{i,j}^{1-\sigma} \quad \forall j \quad (3)$$

where θ_i is country i 's share in world income. Anderson and van Wincoop refer to consumer price indexes as multilateral resistances, as they depend on all bilateral resistances.

Secondly, a gravity equation is derived:

$$x_{ij} = \frac{y_i y_j}{y^w} \left(\frac{t_{ij}}{P_i P_j} \right)^{1-\sigma} \quad (4)$$

where y_w denotes world GDP.

According to equation (4), the value of exports from country i to country j , after controlling for size, is negatively correlated with the trade barrier between both countries and positively correlated with each country's multilateral resistance. It is clear that, given a trade barrier between country i and country j , a rise in country's j multilateral resistance makes country i 's products relatively cheaper and, hence, the value of exports is increased. However, it is less obvious why a higher multilateral resistance in the exporter country i also rises the value of exports to j . According to the model, if a country i exporter faces higher trade barriers the demand for its products in partner countries will lower and, hence, the supply price will decline. Therefore, for a given trade barrier between country i and country j , an increase in i 's multilateral resistance will increase the value of exports.

Finally, the unobservable trade cost factor is modelled as a function of observables. Among the elements that may explain the trade cost factor distance and the existence of a border are considered to exert a very important role. Taking a log-linear function, t_{ij} can be modelled as:

$$t_{ij} = b_{ij} d_{ij}^{\rho} \quad (5)$$

where d is distance, ρ is the distance parameter and b_{ij} is a parameter which takes the value 1 if the trade partners are the same country and 1 plus the tariff equivalent of the border barrier if i and j are not the same country. Equation (5) can be expanded to include other factors, such as linguistic similarity or adjacency, that may affect the bilateral trade cost.

Substituting equation (5) in equation (4) and taking logs we derive the gravity equation that will be used to estimate the distance coefficient and the border barrier coefficient in each bilateral trade among EU countries; if n is the number of countries that are included in our sample, we estimate $[n*(n-1)]/2$ bilateral border barriers¹. The gravity equation to estimate becomes:

$$\ln\left(\frac{x_{ij}}{y_i y_j}\right) = \alpha + \mu \ln d_{ij} + a_{12} \delta_{ij} + \dots + a_{(n-1)n} \delta_{ij} + \ln P_i^{\sigma-1} + \ln P_j^{\sigma-1} + \varepsilon_{ij} \quad (6)$$

where α is the constant term², μ the distance coefficient: $(1-\sigma)\rho$ and ε the error term. Parameters a_{12} to $a_{(n-1)n}$ denote the border coefficient of each bilateral trade $((1-\sigma)\ln b_{ij})$; δ_{ij} takes the value of 1 if country i and country j are those that correspond to a coefficient's subscripts (independent of the order) and zero otherwise.

The main difference between the equation estimated by Anderson and van Wincoop and previous studies, such as McCallum (1995), is the introduction of multilateral resistance terms in the equation. The model developed by Anderson and van Wincoop shows that multilateral resistances are correlated with distance and the border effect and, hence, if they are not included in the equation an omitted variable bias can arise. On the other hand, as opposed to McCallum's type equations, the Anderson and van Wincoop's model imposes unitary income elasticities.

The difficulty in estimating equation (6) lies in the quantification of multilateral resistances. Some authors use price indices to proxy them (Head and Mayer, 2000; Baier and Bergstrand, 2001). However, as explained in Feenstra (2003) and in

Anderson and van Wincoop (2004), this procedure is problematic. Firstly, price indexes, such as the consumer price index, include both tradable and non-tradable products; moreover, prices may differ across countries due to local taxes; in addition to that, short term fluctuations in the exchange rate may introduce big differences in the price index across countries. Secondly, Anderson and van Wincoop (2003) argue that differences in multilateral resistances may also reflect non-pecuniary costs, as consumer preferences for domestically-produced goods.

Another approach is to substitute multilateral resistances by country specific dummies (Hummels, 1999; Rose and van Wincoop, 2001; Feenstra and van Wincoop, 2002; Chen, 2004). More specifically, let τ_i^e denote an indicator variable whose value is 1 if country i is the exporter and zero otherwise, and τ_j^m an indicator variable whose value is 1 if country j is the importer and zero otherwise. Then the gravity equation (6) can be re-written as:

$$\ln\left(\frac{x_{ij}}{y_i y_j}\right) = \alpha + \mu \ln d_{ij} + a_{12} \delta_{ij} + \dots + a_{(n-1)n} \delta_{ij} + \lambda_1 \tau_i^e + \lambda_2 \tau_j^m + \varepsilon_{ij} \quad (7)$$

where $\lambda_1 = \ln P_i^{\sigma-1}$ and $\lambda_2 = \ln P_j^{\sigma-1}$.

A final approach, followed by Anderson and van Wincoop (2003), is to solve multilateral resistances as an implicit function of observables and the parameters of the model. More specifically, if the trade cost function is substituted in equation (3) multilateral resistances are expressed as:

$$P_j^{1-\sigma} = \sum_i P_i^{\sigma-1} \theta_i e^{\mu \ln d_{ij} + a_{12} \delta_{ij} + \dots + a_{(n-1)n} \delta_{ij}} \quad (8)$$

Multilateral resistances implicit solutions are substituted in equation (6). Now, the right-hand side of equation (6) is written as a function of observables and parameters to estimate. Parameters are estimated with non-linear least squares, which minimizes the sum of squared errors³.

Although the second and third procedures yield consistent estimates, as Anderson and van Wincoop point out, the latter procedure is more efficient because it uses information of the full structure of the model. Hence, we use this approach in our estimation.

Finally, it is important to highlight that the Anderson and van Wincoop (2003) model is not free of limitations. Some authors have pointed out that some assumptions of the model, such as the one-sector economy and the absence of a non-tradable sector, are not very realistic; on the other hand, other authors have highlighted that some of the predictions of the model, such as too high trade barriers or large differences in countries' multilateral resistances, cast some doubts on the validity of the model (Balistreri and Hillberry, 2002; Helliwell, 2003). Although Anderson and van Wincoop (2004) defend the validity of their theoretical framework against these criticism, they also recognise that some extensions of the model that overcome some of its limitations would improve the estimation of border barriers.

3. Data

As we do not have real data on intra-national trade in EU countries, following previous studies (Wei, 1996; Head y Mayer, 2000; Nitsch, 2000; Chen, 2004) we have to input them. The assumption is that intra-national trade is the difference between production and exports. Production data is obtained from the OECD STAN Industrial Structural Analysis data-base version 2004 release 4. The STAN data-base is primarily based on OECD member countries' Annual National Accounts by activity tables and uses data from other sources, such as national business surveys/censuses, to estimate any missing detail. This data-base provides complete gross production data for ten EU countries in the 1991-2001 period: Austria, Denmark, Finland, France, Germany, Italy, Netherlands, Spain, Sweden and United Kingdom⁴. Total exports and bilateral exports data among EU countries are obtained from the OECD ITCS data-base and the STAN bilateral trade data-base version 2004 release 1. The sample covers a total of 1100 observations [((10 countries x 9 partners) trade flows + 10 intra-national trade flows) x 11 years].

When available, gross production data are transformed to constant values using STAN data-base's gross production volume index; when this index is missing we use the value-added volume index provided by the same source. In order to compute gross merchandise production we subtract gross production of services, gross production of electricity, gas and water supply, and gross production in construction from the total gross production figure⁵. Trade figures are also converted to constant values using each EU country's trade deflator from the OECD *National Accounts*⁶.

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Data on EU countries' real GDP is obtained as well from the OECD *National Accounts*.

Following Helliwell and Verdier (2001) and Chen (2004), we calculate intra-national distance as a regional GDP weighted average of the great circle distance among a country's regions and the great circle distance within each region. The distance among countries is calculated as a regional GDP weighted average of the great-circle distance between one country's regions and the partner country's regions⁷.

4. Estimation

Table 1 presents the result of the estimation. In the first estimation we assume that the border barrier is equal in all EU countries' bilateral trade ($a_{12} = a_{13} = \dots = a_{n(n-1)}$). The border coefficient is -1.60. If we assume, as in Anderson and van Wincoop (2003), that the elasticity of substitution between domestic and foreign goods is five, the existence of borders impose a barrier which is, as average, equivalent to a 49% tariff.

In a second analysis, we drop the common border barrier assumption, and estimate the model with a border coefficient for each bilateral trade among EU countries⁸. As can be seen in the table, there are large differences across EU countries' bilateral border coefficients. In some cases, such as Netherlands-Finland and Netherlands-Denmark, the border coefficients are almost zero. According to this result, the costs for a Dutch firm when it trades with a Danish or Finnish firm are the same as those

when it trades with a Dutch firm, once we control for differences in transport costs. This is a remarkable result, as it means that in some bilateral trade flows the additional costs that borders may entail, such as differences in language, legal systems and the existence other information costs, seem to have already disappeared. On the other hand, in other bilateral trade flows, such as Austria-France, Austria-Italy and Austria-Spain, the border coefficient is higher than two; if we assume, as before, an elasticity of substitution equal to five, in those bilateral trade flows borders still impose a barrier equivalent to more than a 70 per cent tariff. It is important to note, as well, that the distance coefficient obtained in the second estimation (-1.49) is larger than the one obtained in the first estimation (-1.16).

Table 2 offers a descriptive analysis of the tariff equivalent of the bilateral border barriers (henceforth border tariffs) estimated by the model; once again, the elasticity of substitution is set at five. As can be seen in the table, the border tariffs are evenly distributed across the 10 percentage point percentiles, except for the first one. The highest number of border tariffs are found in the 10%-20% and in the >60% percentile (eight) and the lowest number in the 0-10% percentile (three). The average border tariff in EU countries' bilateral flows is 38%.

Table 2 also presents how each country's border tariffs are distributed across the percentiles and its average. The country with the lowest border tariffs is Netherlands: six of its border tariffs are in the 0%-20% range and the average is 15%. The second country is Denmark where five of its border tariffs are in the 0%-20% range and the average is 22%; these countries are followed by Germany (28% average), United Kingdom (33%) and Finland (34%). The countries with the highest border tariffs are

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Austria, where seven of its border tariffs are above 40% (with a 54% average), Spain (52% average), France (50%), Italy (48%) and Sweden (44%).

5. Conclusions

The studies that have analysed the extent of home-bias in the EU have assumed that the barriers that borders impose on trade were equal in all trade flows among EU countries. In this paper we test the validity of this assumption and calculate the tariff equivalent of the trade barrier in each bilateral trade among EU countries. We found that there are large differences in the barrier that borders impose on bilateral trade. In some cases, such as in Netherlands - Denmark and Netherlands - Finland bilateral trade the border barrier is nil; this result is outstanding, as it means that in some bilateral trade flows the additional costs that borders entail seem to have already disappeared. In other cases, such as Austria-France, Austria-Italy and Austria-Spain, borders still impose a barrier equivalent to more than a 70 per cent tariff. The results also show that some countries have low border barriers in most of their bilateral trade flows with other EU countries, whereas other countries persistently show large border barriers.

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Table 1. Results of the estimation (non-linear least squares)

	Estimation 1: Common border coefficient		Estimation 2. Border coefficient in each bilateral trade among EU countries									
			Austria	Denmark	France	Finland	Germany	Italy	Netherlands	Spain	Sweden	United Kingdom
Austria			-	-1.39 (0.13)	-2.30 (0.07)	-1.64 (0.12)	-0.88 (0.12)	-2.23 (0.06)	-0.82 (0.12)	-2.28 (0.10)	-2.00 (0.09)	-1.68 (0.09)
Denmark			-1.39 (0.13)	-	-1.12 (0.11)	-0.23 (0.13)	-0.70 (0.09)	-1.04 (0.11)	-0.02 (0.14)	-1.27 (0.12)	-0.68 (0.08)	-0.43 (0.12)
France			-2.30 (0.07)	-1.12 (0.11)	-	-1.57 (0.11)	-1.46 (0.05)	-1.71 (0.04)	-1.02 (0.08)	-1.76 (0.05)	-1.81 (0.07)	-1.74 (0.04)
Finland			-1.64 (0.12)	-0.23 (0.13)	-1.57 (0.11)	-	-0.92 (0.09)	-1.71 (0.10)	-0.02 (0.14)	-1.90 (0.15)	-1.39 (0.06)	-0.62 (0.12)
Germany			-0.88 (0.12)	-0.70 (0.09)	-1.46 (0.05)	-0.92 (0.09)	-	-1.39 (0.04)	-0.50 (0.08)	-1.31 (0.07)	-1.45 (0.06)	-1.08 (0.06)
Italy			-2.23 (0.06)	-1.04 (0.11)	-1.71 (0.04)	-1.71 (0.10)	-1.39 (0.04)	-	-0.62 (0.09)	-1.95 (0.06)	-1.95 (0.07)	-1.21 (0.07)
Netherlands			-0.82 (0.12)	-0.02 (0.14)	-1.02 (0.08)	-0.02 (0.14)	-0.50 (0.08)	-0.62 (0.09)	-	-0.77 (0.09)	-0.42 (0.08)	-0.61 (0.09)
Spain			-2.28 (0.10)	-1.27 (0.12)	-1.76 (0.05)	-1.90 (0.15)	-1.31 (0.07)	-1.95 (0.06)	-0.77 (0.09)	-	-2.06 (0.11)	-1.58 (0.07)
Sweden			-2.00 (0.09)	-0.68 (0.08)	-1.81 (0.07)	-1.39 (0.06)	-1.45 (0.06)	-1.95 (0.07)	-0.42 (0.08)	-2.06 (0.11)	-	-1.03 (0.08)
United Kingdom			-1.68 (0.09)	-0.43 (0.12)	-1.74 (0.04)	-0.62 (0.12)	-1.08 (0.06)	-1.21 (0.07)	-0.61 (0.09)	-1.58 (0.07)	-1.03 (0.08)	-
Border coefficient		-1.60 (0.05)										
Distance		-1.16 (0.02)	-1.49 (0.04)									
Adjusted R-square		0.86	0.98									
Number of observations		1100	1100									
Degrees of freedom		1087	1043									

Note: heteroscedasticity robust standard errors are given in parenthesis.
The regression includes time dummies. They are not reported in the table.

Table 2. Distribution of the bilateral border barriers' tariff equivalents

	0%-10%	10%-20%	20%-30%	30%-40%	40%-50%	50%-60%	>60%	Total	Average tariff equivalent (%)
All	3	8	7	5	7	7	8	45	38
Austria	0	0	2	0	1	2	4	9	54
Denmark	2	3	1	2	1	0	0	9	22
France	0	0	1	1	2	4	1	9	50
Finland	2	1	1	0	2	2	1	9	34
Germany	0	2	2	2	3	0	0	9	30
Italy	0	1	1	1	1	2	3	9	48
Netherlands	2	4	3	0	0	0	0	9	15
Spain	0	0	1	2	1	1	4	9	52
Sweden	0	2	1	0	2	1	3	9	44
United Kingdom	0	3	1	2	1	2	0	9	33

¹ Note that, by assumption, $t_{ij}=t_{ji}$ and hence $b_{ij}=b_{ji}$.

² The natural logarithm of Y^w .

³ Analytically the system is solved as:

$$\min_{a_1, a_2, a_3} \sum_i \sum_j [\ln z_{ij} - \alpha - \mu \ln d_{ij} - a_{12} \delta_{ij} - \dots - a_{(n-1)n} \delta_{ij} + \ln P_i^{1-\sigma} + \ln P_j^{1-\sigma}]^2$$

$$\text{subject to } P_j^{1-\sigma} = \sum_i P_i^{\sigma-1} \theta_i e^{\mu \ln d_{ij} + a_{12} \delta_{ij} + \dots + a_{(n-1)n} \delta_{ij}} \quad \forall j$$

⁴ It should be pointed out that Austria, Finland and Sweden were not members of the European Union until 1995.

⁵ These figures are also transformed to constant values using, when available, the volume indices provided by the STAN data-base.

⁶ From the total merchandise trade figure we subtract trade in Scrap metal, trade in Electricity, gas and water supply and trade in Others. When these sectoral data were not available we inputted it using the average share of each sectoral trade in total merchandise trade from the years where the data were available.

⁷ The regional disaggregation matches Eurostat's NUTS 2 classification. We use the average regional GDP in the 1995-1999 period as weight. Regional GDP was obtained from Eurostat's Regio data-base. As Denmark only provides GDP data on a country-level we defined as regions the four most populated cities and population was used as weight.

⁸ We estimate 45 bilateral border coefficients. However, we present them twice in the table to make it easier to read.